Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

1.280.39
R31A
cop. 2

ARS 51-1
October 1964

Relationship of Fungicides and Field Spacings to

BOTRYTIS NECK ROT OF ONIONS

Grown in New York

U. S. DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY
JAN 8 - 1965
C & R-PREP.

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

PREFACE

The authors acknowledge the cooperation and assistance of Stanley Wiecek, Harold Utter, William Plecan, and Ben Kata, Orange County onion growers; Horace A. Smith, Jr., Associate Agricultural Agent, Orange Co.; Ralph Gillard, Genesee County onion grower; Ken Stone, Regional Vegetable Specialist, Cornell University, and S. O. Kawamoto and R. Louie, Graduate Research Assistants, Cornell University. The Orange County Vegetable Improvement Cooperative Association, Inc., and the Campbell Soup Company provided grants to the Department of Plant Pathology at Cornell University in partial support of the investigation described in this report.

Brand names of the products used in the tests are given for identification only, and do not constitute endorsement by the U.S. Department of Agriculture for these products, or imply discrimination against other products.

CONTENTS

	Page
Summary	ii
Introduction	1
Methods and materials	1
Field application of fungicidal sprays	1
Spacing trials	2
Postharvest treatments	3
Results	5
Effects of field applications of fungicidal sprays on Botrytis neck rot in storage	5
Effects of field plant spacings on Botrytis neck rot in storage	5
Effects of postharvest treatments on Botrytis neck rot in storage	5
Discussion	6

SUMMARY

Tests were conducted during the 1962-1963 season to study the effect of foliar sprays for the control of leaf blight caused by Botrytis squamosa, on the subsequent incidence of Botrytis neck rot caused by Botrytis allii in storage. Additional tests were conducted to study the control of Botrytis neck rot by variable spacing of onion plants in the field and by postharvest sprays and dips of onion bulbs.

Sprays which controlled Botrytis leaf blight in the field, resulting in increased yields, simultaneously delayed the maturity of the bulbs. This increased the greenness and succulence of the necks at harvest and thus predisposed the bulbs to greater decay by Botrytis neck rot in storage.

Close spacing of the plants in the field resulted in onions with small necks, which cure better than onions with large necks. After 2 months in storage Downing Yellow Globe variety developed 4.9 percent decay when the plants were spaced 7 per foot, compared with 1.2 percent when they were spaced 12 plants per foot. Less decay in the Elite variety also developed after 2 months' storage when the plants were spaced close together. Differences between spacing treatments were not marked after 4 months' storage.

Dipping onions after harvest in several fungicidal solutions did not control decay in storage.

Relationship of Fungicides and Field Spacings to Botrytis Neck Rot of Onions Grown in New York[1]

by J. Kaufman,[2] J. W. Lorbeer,[3] and B. A. Friedman[2]

INTRODUCTION

Effective control of foliar diseases with fungicides and the adoption of late-maturing varieties has extended the growing period of onions on muck soil in New York State. These practices, along with early harvesting, have frequently resulted in the production of immature onion bulbs at harvest. In addition, poor or uneven onion stands frequently have resulted in the growth of many large onions with thick necks; these onions are delayed in their maturity and curing (drying of the tops and necks). Because infection by Botrytis allii causing Botrytis neck rot takes place primarily through the cut neck, it follows that the greener and larger the necks at harvest, the greater is the predisposition to decay.

Tests were conducted during the 1962-63 season to determine: (1) The effect of foliar fungicidal sprays in the field on decay of onions after storage, (2) the effect of three field spacings of onion plants on the incidence of Botrytis rots in storage, and (3) the effect of post-harvest fungicidal dips and Botrytis allii inoculations of topped and nontopped onions on the incidence of Botrytis neck rot in storage.

METHODS AND MATERIALS

Field application of fungicidal sprays.--Elite variety onions were grown in a randomized block design trial. Each plot was 24 feet long and consisted of 4 rows, 15 inches apart. The onions averaged about 10 per foot. In the field the plants were sprayed with a number of foliar fungicides as shown in table 1. The bulbs from only the center 20 feet of row of the middle two rows of the four-row plot were harvested and topped. Harvesting was done on September 6, 1962, except for Botran-treated lots and the untreated controls which were harvested on August 31. The onions from all treatments were cured in the field until October 17 and 18 in stacked slotted crates. The upper surface of the stacks was covered with canvas. They were then graded for size, decay, and other defects.

About 6 inches of rain fell during the curing period; the temperatures ranged from 85° to 37° F.,[4] averaging about 60° F. After removal of the defective bulbs, the onions were put back into field crates and placed in common storage in Orange County, N.Y. In storage, the temperatures, recorded with thermographs placed in the center of each of 2 crates, were:

November 13 to 30, average 48° F., range 46° to 54° F.;
December 1 to 31, average 45° F., range 40° to 52°;
January 1 to 24, average 43° F., range 36° to 53°.

On January 24, the onions were transferred to the New York laboratory. In this and subsequent tests, one-third of the onions were examined on arrival, one-third after 1 week, and one-third after 2 weeks at 70° F. All onions were sized and examined for external decay. They were then cut lengthwise to determine internal decay.

---

[1] The Department of Plant Pathology, Cornell University, Ithaca, N.Y., cooperated with the Market Quality Research Division, Agricultural Research Service, in this study.

[2] Plant Pathologists, Market Pathology Laboratory, Market Quality Research Division, Agricultural Research Service, U.S.D.A., New York City. Dr. Friedman is now deceased.

[3] Assistant Professor, Department of Plant Pathology, Cornell University, Ithaca.

[4] U.S. Weather Bureau. Climatological Data for New York. 74 (9 and 10). Sept.-Oct. 1962.

Spacing trials.--In a randomized block design with four replications, onions were spaced at 7, 9.5, and 12 plants per foot for the Downing Yellow Globe variety and at 8.8, 9.2, and 12.3 plants per foot for the Elite variety (table 2). Each plot consisted of 4 rows, 100 feet long, spaced 15 inches apart. Customary insect and disease control schedules and fertilization programs were used. The onions were harvested mechanically and topped by cutting off the leaves at the bulb-neck region. Two hundred pounds of bulbs per treatment were field-cured from September 7 to 19, and placed in common storage. The temperatures during curing averaged about 64° F.,

TABLE 1.--Decay of Elite onion bulbs after about 5 months' storage[1]

Treatment[2]		Rate per acre	Yield per acre (50-lb. bags)	Leaf lesions	Botrytis neck rot	Other decays
Number	Chemical		Number	Number[3]	Mean Percent[4]	Percent
2.	Maneb - 80 WP[5]	3 lb.	1,140	1	19.0 a	0.4
3.	Maneb - 80 WP[5]	1 1/2-3 lb.	1,190	3	15.5 ab	.5
9.	Dithane M-45	3 lb.	1,230	2	15.4 abc	.6
5.	Maneb (Plyac) 80 WP	3 lb.	1,134	3	14.8 abcd	.5
4.	Maneb - 80 WP	3 lb.	1,180	2	13.0 abcde	.3
10.	Nabam-22% Sol. plus $ZnSO_4$	2 qts. 3/4 lb.	1,150	18	10.9 bcde	.2
7.	Dyrene - 50 WP	3 lb.	1,216	16	10.1 bcde	.2
6.	Botran - 50 WP	2 lb.	1,030	87	9.1 bcde	.3
8.	Amobam - 42% Sol. plus $ZnSO_4$	1 qt. 3/4 lb.	1,074	25	8.0 bcde	.5
1.	Check (None)	-	986	89	6.4 e	.3

[1] Onions harvested from Botrytis leaf blight spray trials.

[2] All treatments applied once weekly except where noted from June 22-August 17. All treatments with B1956 spreader-sticker except Plyac. 80 WP = 80-percent wettable powder; 50 WP = 50 percent wettable powder.

[3] Average number of lesions per leaf caused by Botrytis squamosa on August 13.

[4] Treatments in a column followed by the same letter are not significantly different when tested by Duncan's Multiple Range Test. The percentages are the averages based on decay in 4 replicates of about 250 onions each. The results of the arrival and holding inspections were combined because of only slight differences in decay.

[5] Treatment 2 applied twice weekly; treatment 3 applied once weekly: 1 1/2 lb. from June 19 to July 24; 3 lb. July 31 to August 21.

TABLE 2.--Botrytis neck rot in stored onions grown at different spacings when freshly harvested and after 1, 2, and 4 months' storage[1]

Variety and spacing (plants per foot)	Neck diameter	Onions examined at indicated number of months' storage				Botrytis neck rot after indicated number of months' storage			
		0	1	2	4	0	1	2[2]	4
	Mm.	Number	Number	Number	Number	Percent	Percent	Percent	Percent
Downing Yellow Globe									
7.0	13.8	533	513	514	755	1.8	1.2	4.9	4.9
9.5	12.1	913	919	959	1,508	.2	1.7	1.5	4.2
12.0	10.7	1,111	1,031	994	1,580	.3	1.1	1.2	3.3
Elite									
8.8	12.0	509	521	471	708	0	2.3	4.2	5.9
9.2	12.7	759	714	654	1,201	.1	3.2	5.5	7.4
12.3	10.7	978	913	840	1,319	.1	1.6	1.9	7.1

[1] The results of the removal and holding inspections were combined because of only slight differences in decay.

[2] LSD at 5 percent level = 1.77; at 1 percent level = 2.45.

ranging from 85° to 40° F. About 1 inch of rain fell during this period[4]. Fifty-pound sam from each of the treatments were brought to the New York laboratory at harvest, and aft and 4 months' storage. At each interval the onions were examined when removed from s and after 1 and 2 weeks at 70° F. as described previously.

Postharvest treatments.--Encore variety onions, after 2 weeks' curing in the field, we divided into two series on September 7. The first series consisted of onions with short, no necks; the second series consisted of onions with 6-inch necks. Both series were washed, dipped (maximum, 1 minute) into the solutions that are listed in table 3. The inoculum for t tests was prepared by mixing *B. allii* spores from 14-day-old cultures at the rate of one la test tube slant per 1/2 gallon of water for each schedule. The onions were dipped briefly in fresh spore suspension for each schedule.

Following each treatment the onions were divided into two lots. One lot was stored in Orang County where it was examined for decay on February 25. The other lot was transferred after treatment to New York City and stored at 53° F. until October 25, and at 47° F. until January 9. One third of the onions were then cut and examined for decay. The remainder was placed at 70° F. Another one-third were examined after 1 week and the remainder after 2 weeks.

Two additional tests were conducted with freshly harvested onions, one with the Early Harvest variety in Orange County (table 4); the other with the Empire variety in Genesee County (table 5). The Early Harvest onions, topped and nontopped, were dipped for about 1 minute in spore suspensions of either *B. allii*, *B. squamosa*, or *B. cinerea*. These onions were held in storage until February, and then examined for decay.

In the second test, onions were harvested in two series on September 21, 1962, from two different fields of different planting dates. The tops and necks of the early planted onions were dry; those of the late planted onions were green and succulent when harvested. Additional tests with these onions involved the use of Maneb and Botran dips and Maneb sprays. These onions were stored until January 30, and then examined for decay.

TABLE 3.--Effect of fungicidal treatment on the control of Botrytis neck rot of stored onions with normal and with 6-inch necks

Treatment	Onions[1] examined	Decay
Normal necks:	*Number*	*Percent*
Water dip	345	1.7
B. allii spore suspension dip	328	23.2
Sorbistat 500 p.p.m. and *B. allii* dip	239	19.2
Penicillin G 500 p.p.m. and *B. allii* dip	340	38.5
Griseofulvin 500 p.p.m. and *B. allii* dip	284	22.5
B. allii and water dips	380	40.8
6-inch necks:		
Water dip	285	9.8
B. allii spore suspension dip	319	27.9
Sorbistat 500 p.p.m. and *B. allii* dip	413	16.7
Penicillin G 500 p.p.m. and *B. allii* dip	407	26.3
Griseofulvin 500 p.p.m. and *B. allii* dip	318	14.8

[1] Combined results of Encore onions held in Orange County September 7, 1962, to February 25, 1963, and in New York City September 7 to January 9 to 23.

TABLE 4.--Effects of water dips and Botrytis spore suspensions on the incidence of Botrytis neck rot in storage[1]

Treatment	Botrytis neck rot[2]
Checks (Not inoculated)	Percent
Topped - Dipped in water	13
Not topped - Dipped entire plant in water	0
Not topped - Dipped only leaves and neck in water	2
Dips in Botrytis spp. spore suspensions	
B. allii spore suspension	100
B. squamosa spore suspension	3
B. cinerea spore suspension	7
B. allii spore suspension (not topped) (entire plant)	61
B. allii spore suspension (not topped) (tops (leaves) and necks only)	36

[1] Early Harvest onions, harvested and stored August 13, 1962; inspected February 20, 1963.
[2] Percentage of decay is based on 100 onions per treatment.

TABLE 5.--Effect of fungicides and inoculation on topped and nontopped stored onions of 2 maturities[1] [2]

Treatment	Onions examined	Decay
Green necks and tops	Number	Percent
Topped - not inoculated	87	11
Topped - inoculated	65	96
Not topped - not inoculated	51	0
Not topped - inoculated	91	45
Topped - Maneb dip[3] - not inoculated	77	18
Topped - Maneb dip - inoculated	54	95
Topped - Maneb spray - not inoculated	95	27
Topped - Maneb spray - inoculated	87	89
Topped - Botran dip[3] - not inoculated	94	24
Topped - Botran dip - inoculated	94	66
Partially dry necks and tops		
Topped - not inoculated	96	4
Topped - inoculated	104	44
Not topped - not inoculated	113	0
Not topped - inoculated	83	14

[1] These tests were conducted at Elba, N.Y. (Genesee County). Empire variety placed in common storage from September 21, 1962, to January 30, 1963.
[2] Inoculation with *B. allii* spores.
[3] Botran and Maneb were prepared by dissolving 9.08 grams of the chemical in one gallon of water.

RESULTS

Effects of field applications of fungicidal sprays on Botrytis neck rot in storage.--of the field sprays on Botrytis neck rot, and other decays, after about 5 months' comn followed by 1 and 2 weeks at 70° F. are summarized in tables 1 and 6. Most of the s occurring in this study was Botrytis neck rot. In general, the more effective the fo schedule in controlling Botrytis leaf blight and thrips, the greater was the incidence neck rot in stored onions. The check lot not sprayed with fungicides had the least amou neck rot, 6.4 percent. In the treated lots the least amounts of decay developed with Amo 8 percent, and Botran, 9.1 percent. These treatments had the greatest number of leaf les and leaf dieback. Most decay developed with the twice-weekly application of Maneb, 19.0 (table 1), a treatment which resulted in excellent control of Botrytis leaf blight and the gre yields. In permitting excellent plant growth and bulbing, this treatment delayed maturity an necks of the onion remained fairly green and succulent until harvest. For every spray sche the larger onions developed greater amounts of Botrytis neck rot in storage (table 6).

Effect of field plant spacings on development of Botrytis neck rot in storage.--Downing Yellow Globe onions stored 2 months in common storage developed 4.9 percent decay when spaced, in the field, 7 plants per foot, compared with only 1.2 percent decay when spaced at 12 plants per foot (table 2). Less decay also developed after 2 months' storage in the Elite variety when the plants were spaced close together. The close spacing results in onions with small neck diameter which cure more easily than onions with large necks. After 4 months' storage, the incidence of Botrytis neck rot increased in both varieties and differences between spacing treatments were not marked.

Effects of postharvest treatments on Botrytis neck rot in storage.--None of the fungicidal treatments tried were effective in reducing Botrytis neck rot in storage of inoculated or non-inoculated onions (tables 3, and 5).

Dipping freshly harvested, topped onions into suspensions of B. squamosa, and B. cinerea failed to produce typical Botrytis neck rot; on the other hand, inoculation with B. allii resulted in a 100-percent infection after slightly more than 5 months' storage (table 4).

TABLE 6.--Effect of preharvest fungicidal sprays and onion size upon Botrytis neck rot of elite onions after about 5 months' storage

Treatment[1]	Onions examined[2]	Decay for size[3]--			Onions examined for size[2]--		
		Large	Medium	Small	Large	Medium	Small
	Number	Percent	Percent	Percent	Number	Number	Number
1. Check (None).............	1,102	20.0	9.2	4.7	5	371	726
2. Maneb.....................	1,054	92.9	21.2	17.4	14	424	616
3. Maneb.....................	1,104	34.6	17.9	12.9	26	521	557
4. Maneb.....................	1,105	40.0	14.8	10.0	20	535	550
5. Maneb (Plyac)............	1,050	20.6	17.0	12.1	34	522	494
6. Botran....................	1,073	60.0	12.1	7.7	5	414	654
7. Dyrene....................	1,160	33.3	9.1	9.9	12	552	596
8. Amobam plus $ZnSO_4$.........	1,078	36.4	10.7	5.6	11	441	626
9. Dithane M-45.............	1,034	42.9	17.1	11.2	21	566	437
10. Nabam plus $ZnSO_4$..........	968	55.6	11.5	9.7	19	452	497

[1] See table 1 for details of treatment.

[2] Total onions for four replicates. The results of the initial and holding inspections were combined because of only slight differences in decay.

[3] Large--Onions 3 inches in diameter and over; medium--2 1/4 to 3 inches; small--under 2 1/4 inches.

the entire harvested plant (tops and bulbs) in a *B. allii* spore suspension resulted cay (61 percent) than when only the tops were inoculated (36 percent).

ed onions had substantially less decay than comparable topped onions. Only 2-percent ped even when the leaves and neck were dipped in water. Complete control of Botrytis chieved in noninoculated onions by harvesting the bulbs with tops intact and storing condition (tables 4 and 5). Comparable topped onions had 4- to 13-percent decay. lated onions, a greater degree of control was obtained in onions with tops and necks dry and intact (14-percent decay, of which 13 percent occurred at the basal plate) than harvested and stored with green tops (45-percent decay) (table 5). Both procedures d in considerable reduction in decay when compared with the two series in which the ere cut and the bulbs artificially inoculated with *B. allii*. Forty-four percent decay oc- d in topped onions with partially dry necks and tops, and 96 percent in topped onions with n necks and tops.

DISCUSSION

These tests indicate that additional work should be done to develop methods for control of decay of onions in storage; perhaps artificial curing that was found beneficial on small lots by a number of investigators could be developed for application on a larger scale. It is doubtful that any type of foliar spray program during the growing season or immediately prior to harvest will result in the control of Botrytis neck rot. The studies indicate that factors which result in succulent and fairly green onion necks at harvest predispose the onions to Botrytis neck rot in storage. Infection for the most part occurred in onions that were topped while the necks were still fairly green and succulent.

CAUTION

Dyrene and Maneb are the only chemicals discussed in this report that have been registered for use on the growing crop in commercial production of onions. They should be used only as described on the label and not used indiscriminately. The other chemicals have not been registered for use.

None of the products discussed in this report have been approved by the Food and Drug Administration for use on onions after harvest and should not be used commercially as postharvest dips for onions.

Improper use of chemicals can be dangerous to humans, domestic animals, fish and wild animals; some fungicides are very poisonous. Chemicals should be kept in closed, well labeled containers, in a dry place where they will not contaminate food or feed, and where children and pets cannot get at them.